NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WATER WELL

(No.)

CODE 642

DEFINITION

A vertical hole drilled, dug, driven, bored, jetted or otherwise constructed to an aquifer.

PURPOSE

Provide water for livestock, wildlife, irrigation, human, and other uses.

Provide for general water needs of farming and/or ranching operations.

Facilitate proper use of vegetation on range land, pastures, and wildlife areas.

CONDITION WHERE PRACTICE APPLIES

This practice applies on all land uses where the underground supply of water is sufficient in quantity and quality for the intended purpose.

This practice standard applies only to production wells. Specifically excluded are any types of wells installed solely for monitoring or observation purposes, injection wells, and piezometers.

The standard does not apply to pumps installed in wells; above ground installations (such as pumping plants, pipelines, and tanks); temporary test wells; and decommissioning of wells (ASTM D 5299).

CRITERIA

Potential effects of installation and operation of the well on cultural, historical, archeological, or scientific resources, at or near the site shall be considered in planning.

Suitability of Site. The availability of ground water for its intended use at the site shall be determined by using reliable local experience and reviewing all available relevant geologic maps and reports; well records maintained by state and federal agencies; and design, construction, and maintenance records of nearby wells. An appropriate level of investigation, including test well drilling, is conducted on-site, as needed, prior to well construction to determine site-specific hydro-geologic conditions.

The site shall be suitable for safe operation of the drilling equipment. **Particular attention must be given to avoid petroleum and natural gas pipelines and buried electrical and fiber optic cables.**

Wellhead Protection. Wells shall be located at safe distances from any potential sources of pollution, including unsealed abandoned wells. The allowable distance shall be based on consideration of site-specific hydrogeologic factors and shall comply with requirements of all applicable state or local regulations or construction codes. **Table 1** shows the minimum setback requirement for installation of wells.

Table 1

Minimum Horizontal Distance between Well-head and Source of Contamination (Feet)

Source of Contamination	Minimum Distance
Waste Disposal Lagoon	300
Cesspool	150
Silo Pit, Seepage Pit	150
Livestock and Poultry Yards	100
Manure Pile, Privy	100
Septic Tank and Disposal Field	100
Gravity Sewer or Drain	50
Standing Water	10

Surface runoff and drainage that might reach the wellhead from potential areas of contamination, such as those used by livestock, shall be diverted. Provisions shall be made to exclude all surface runoff and drainage water from within ten feet of the wellhead, as a minimum. The level of protection will be as required by the 25-year 24-hour storm event.

Wells shall be located a safe distance from both

overhead and underground utility lines and other safety hazards.

The wellhead should be reasonably protected from damage that might be incurred by livestock, vehicles, acts of carelessness, and vandalism.

Borehole. Wells shall be sufficiently round, straight, and of adequate diameter, to permit satisfactory installation of inlet, well casing, filter pack, annular seal, and passage of tremie pipe (including couplings), if used. Drilled wells shall be sufficiently plumb and straight to permit satisfactory installation and operation of a pump of the designed size and type to the greatest anticipated depth of setting. Tests for plumb and alignment may be made after completed construction of the well.

Use of Casing. Casing shall be installed to seal out undesirable surface or shallow ground water and to support the side of the hole through unstable earth materials. The intake portion of a well through stable geologic formations may not require casing.

Casing Diameter. Casing diameter shall be sized to permit satisfactory installation and efficient operation of the pump, and large enough to assure the up-hole velocity is 5 feet per second or less, to protect against excessive head loss.

Casing Materials. Casings may be of steel, iron, stainless steel, copper alloys, plastic, fiberglass, or other material of equivalent strength and durability consistent with the intended use of the water and the maximum anticipated differential head between the inside and outside of the casing. Asbestos cement pipe shall not be used.

Only steel pipe casings shall be used in driven wells.

To prevent galvanic corrosion, dissimilar metals shall not be joined.

Minimum Thickness of Well Casing. The primary loading on well casing is external pressure rather than internal pressure. The designer shall determine the anticipated hydraulic collapse and apply a factor-of-safety of no less than 2 in determining the necessary wall thickness for the each type of casing material that will be accepted during installation of the well. The maximum depth for well casings is the difference in static head between the inside and outside of the casing. The difference will probably be greatest during operation. Caution should be used in determining this difference in head, as it is rarely the total depth of the well.

The following Items influence head difference:

- Drilling method,
- Well yield, and
- Draw down of aquifer.

Well casing wall thickness shall be sufficient to withstand all anticipated static and dynamic pressures imposed on the casing during installation, well development, and use. The same wall thickness and material shall be used for the entire casing.

Joint Strength. Joints for well casings shall have adequate strength to carry the load due to the casing length and still be watertight, or shall be mechanically supported during installation to maintain joint integrity. Such mechanically supported casings shall terminate on firm material that can adequately support the casing weight.

Screen. Well screens shall be installed in any aquifer material likely to produce silt or sand. Well screens may be constructed of commercially manufactured screen sections, well points, or field-perforated sections.

The screen shall be constructed with the slot width determined from aquifer samples (Part 631, NEH, Chapter 33). Perforation by any method is allowable provided proper slot size and entrance velocity limits can be met. Screen open areas can range from 1 percent of the total area for field-perforated screens to 25 percent of the total area or more for continuous wire-wrapped screens. To assure good well efficiency, open areas should be designed to approximate aquifer porosity. High open area percentages also make well development more effective. The length and open area of the screen shall be sized to limit entrance velocity of water into the well to less than or equal to 0.1 foot per second (Part 631, NEH, Chapter 33, Example 33-2).

Depth of the aquifer below ground surface and the thickness of aquifer to be penetrated by the well shall govern the position of the screen in the well.

Maximum drawdown shall not be permitted below the top of the highest screen or pump intake.

Seals (Packers). Telescoped screen assemblies shall be provided with one or more sand-tight seals between the top of the telescoped screen assembly and casing.

Filter Pack. Installation of a filter pack around the well screen shall be considered under the following conditions: presence of a poorly graded, fine sand aquifer; presence of a highly variable aquifer, such as alternating sand and clay layers; presence of a poorly cemented sandstone or similar aquifer; a requirement for maximum yield from a low-yielding aquifer; and holes drilled by reverse circulation.

Pre-Packed Well Screens. For heaving or caving sands, silty or fine-grained aquifers, and for horizontal or angled wells, a commercial pre-packed well screen may be substituted for a conventionally installed (by tremie) filter pack.

Installation. Casing shall extend from above the ground surface down through unstable earth materials to an elevation of at least 2 feet into stable material or to the top of the screen.

All wells shall be cased to a sufficient height (minimum of 12 inches) above the ground surface to prevent entry of surface and near-surface water.

Casing for artesian aquifers shall be sealed into overlying, impermeable formations in such a manner as to retain confining pressure.

If a zone is penetrated that is determined or suspected to contain water of quality unsuitable for the intended use, the zone shall be sealed to prevent infiltration of the poor-quality water into the well and the developed portion of the aquifer.

Well Development. Well development shall be performed to repair damage done to the formation by the drilling process, and to alter the physical characteristics of the aquifer surrounding the borehole so that water will flow more freely to the well.

The method of well development used shall be selected based on geologic character of the aquifer, type of drilling rig, and type of screen.

Aquifer Development. For massive, unfractured rock formations that is unresponsive to well development procedures, the use of aquifer stimulation techniques may be considered to improve well efficiency and specific capacity. Techniques may include dry ice, acidizing, explosives, or hydrofracturing, depending on the composition and structure of the formation.

Grouting and Sealing. The annulus surrounding the permanent well casing at the upper terminus of the well shall be filled with mortar containing expansive hydraulic cement (ASTM C 845), or bentonite-based grout. The length of the grout seal shall be no less than 10 feet and not less than the minimum specified in state or locally applicable construction codes.

If the water is intended for human consumption, the casing shall be surrounded at the ground surface by a 4-inch thick concrete slab extending at least 2 feet in all directions, continuous with the grout seal and sloping away from the well cap. The base shall be free from cracks, voids or other significant defects likely to prevent water tightness. Contacts between the base and the annular seal, and the base and the well casing, must be watertight and must not cause the failure of the annular seal or well casing.

A positive seal (grouted in place) or packer shall be provided between the casing and the less pervious material overlying the aquifer of artesian wells, and in all aquifers where co-mingling of waters is undesirable.

Access Port. An access port with a minimum diameter of ¾ inch shall be installed to allow for unobstructed measurement of depth of the water surface, or for a pressure gage for measuring shut-in pressure of a flowing well. Access ports and pressure gages or other openings in the cover shall be sealed or capped to prevent entrance of surface water or foreign material into the well. Removable caps are acceptable as access ports.

Disinfection. Wells shall be disinfected immediately following their construction or repair to neutralize any contamination from equipment, material, or surface drainage introduced during construction. The disinfection process shall comply with all local or state requirements.

Riser Pipe. Friction loss for plastic pipe may be computed using the Hazen-Williams

equation and a roughness coefficient, "C", equal to 150 or the Manning's equation and a roughness coefficient, "n", equal to 0.009.

The design flow velocity of the riser pipe at system capacity should not exceed 5 ft/sec to reduce friction loss.

Water Quality Testing. Sampling and testing shall comply with all applicable federal, state, and local requirements. These requirements vary according to the water quality parameters associated with the intended use(s) of the water. (See also Conservation Practice Standard Code 355, "Well Water Testing.")

CONSIDERATIONS

The potential for adverse interference with existing nearby production wells needs shall be evaluated in planning.

The potential for ground water overdraft and the long-term safe yield of the aquifer shall be considered in planning.

If practicable, wells should be located in higher ground and up gradient from sources of surface contamination or flooding. In determining gradient, both pumped and unpumped conditions shall be considered.

Potential effects of installation and operation of the well on cultural, historical, archeological, or scientific resources at or near the site shall be considered in planning.

DRAWINGS AND SPECIFICATIONS

Drawings and specifications shall be prepared for specific field sites in accordance with this standard and shall describe the requirements for applying the practice to achieve its intended uses.

OPERATION AND MAINTENANCE

A plan for maintenance of a well shall be prepared. The well construction records shall be kept on file with the maintenance plan by the owner/operator. As a minimum, the plan shall include a statement of identified problems, corrective action taken, date, and specific capacity (yield per unit drawdown) of well before and after corrective action was taken.

The well site must be readily accessible for, drilling, operation, maintenance, and repair.

A properly operated and maintained well is an asset to your farm. This well was designed and installed to provide water utilization. The estimated life span of this system is at least 20 years. The life of this system can be assured and usually increased by developing and carrying out a good operation and maintenance program.

The following are some recommendations to help develop a good operation and maintenance program.

- Maintain the well cover securely in place.
- Protect the area from being damaged by agriculture machinery, vehicles, or livestock.
- All fences, railings, and/or warning signs shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.
- Do not allow any foreign debris to accumulate in the immediate vicinity.
- Maintain soil and vegetative covering to the design conditions.
- Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.
- Check metal surfaces for rust and other damage especially sections in contact with earth fill and with other materials. Repair or replace damaged section and apply paint as a protective covering.
- Keep all surface water from entering or accumulating at the immediate vicinity of the well site.
- Immediately repair any vandalism, vehicular, or livestock damage to any earth fill, spillways, or outlets.

REFERENCES

National Engineering Handbook, Part 631, Chapter 33, Investigations for Ground Water Resources Development.

Rules and Regulations Governing Drilling of Wells and Appropriation and Use of Ground Water in New Mexico, New Mexico Office of the State Engineer.

NRCS Practice Standard Code 516, Pipeline

AWWA Standard for Water Wells, ANSI/AWWA A 100.

Groundwater and Wells, Fletcher G. Driscoll, 1986.